HETA 98-0050-2733
Meritor Automotive, Inc.
Heath, Ohio

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PREFACE

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Douglas Trout, MD, MHS and John Decker, MS, CIH of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Angela Weber, MS. Desktop publishing was performed by Patricia C. McGraw. Review and preparation for printing was performed by Penny Arthur.

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Health Hazard Evaluation Report 98-0050-2733
Meritor Automotive, Inc.
Heath, Ohio
April 1999

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SUMMARY

In November 1997 the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from representatives of Meritor Automotive, Inc., the United Auto Workers (UAW) Local 1037, and the International Brotherhood of Electrical Workers (IBEW) Local 1206. The request concerned potential health hazards related to exposure to metalworking fluids (MWF) among employees at the Meritor facility in Heath, Ohio, which produces truck axles. In response to this request, NIOSH investigators conducted a site visit on February 10-11, 1998.

The site visit included a walk-through inspection of the machining areas, interviews with employees and the facility's contract physician, and industrial hygiene sampling. Nine full-shift personal breathing zone (PBZ) air samples for MWF were collected and analyzed by a method used by NIOSH to separate MWF from co-sampled material. Seventeen bulk samples of MWFs were collected and analyzed for fungi, aerobic bacteria, and mycobacteria.

The total particulate mass concentrations of MWF ranged from 0.33 to 1.29 milligrams per cubic meter (mg/m^3). Five samples had concentrations over the 0.5 mg/m^3 NIOSH Recommended Exposure Limit (REL) for MWF. The MWF aerosol concentrations in four of these five samples remained in excess of the REL even when other airborne aerosols were removed with the extraction method. *Mycobacterium chelonae* was the most frequently isolated organism from machine sumps; a variety of other bacteria, all Gram-negative, were also isolated from various MWFs. Some MWFs had bacteria concentrations ranging from 10^5 - 10^7 colony forming units per milliliter (CFU/ml), suggesting the need for improved maintenance.

Informal interviews with employees working in machining areas revealed that a number of employees had experienced respiratory symptoms in the recent past. To further evaluate reported symptoms among Meritor employees exposed to MWF, a questionnaire was distributed by mail in November 1998 to all plant employees. One hundred thirty-one (15%) of the 852 questionnaires sent out for the medical survey were returned. Thirty-nine (30% of 131) employees reported work-related respiratory symptoms. Ten participants who had been identified by the questionnaires as potentially having MWF-related respiratory illness were offered clinical pulmonary (lung) evaluations at the the University of Cincinnati Center for Occupational Health; none of the participants chose to receive the evaluations.

Exposures to MWF at concentrations above the NIOSH REL are occurring among employees in several of the machining departments at Meritor. Although no conclusions can be drawn regarding the prevalence of respiratory symptoms among Meritor employees, a number of Meritor employees did report work-related respiratory symptoms. To help prevent respiratory disorders associated with MWF exposure, NIOSH recommends that MWF aerosol concentrations be reduced to levels below the NIOSH REL. In addition, NIOSH recommends that a comprehensive safety and health program concerning potential exposure to MWFs be developed and implemented as part of the employer's management system. These and other recommendations are included in this report.

KEYWORDS: SIC 3714 (Motor vehicle parts and accessories) hypersensitivity pneumonitis, metalworking fluids, machining, *Mycobacterium chelonae*

TABLE OF CONTENTS

INTRODUCTION

In November 1997 the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from representatives of Meritor Automotive, Inc., the United Auto Workers (UAW) Local 1037, and the International Brotherhood of Electrical Workers (IBEW) Local 1206. The request concerned potential health hazards related to exposure to metalworking fluids (MWF) among employees at the Meritor facility in Heath, Ohio. In response to this request, NIOSH investigators conducted a site visit on February 10-11, 1998. Interim letters, reporting results of the industrial hygiene survey, were distributed to the company and union representatives in March and July, 1998.

BACKGROUND

The Meritor Automotive facility in Heath, Ohio is a machining and assembly facility which primarily produces truck axles. During 1990-1991, a NIOSH HHE (HETA 90-368-2137) was conducted at the facility to evaluate worker exposures to diisocyanates in the axle painting operation. Since that time, the diisocyanate paints have largely been eliminated. In early 1997, a machinist at Meritor was diagnosed with hypersensitivity pneumonitis (HP), thought by the consulting physicians to be related to the machining environment.

Approximately 1,000 employees work in the 17.5-acre building, which was constructed in the 1950s. Among 854 hourly employees, 338 (40%) work in departments performing machining operations ('machining departments'). The facility operates 24 hours per day, 7 days per week (the third shift has only a skeleton crew). A wide variety of machining operations are conducted. Some machines are automated and have multiple functions (for example the 21-station Bendix has drilling, boring, milling, threading, etc.). There are eight central MWF systems and numerous stand-alone sumps. Four primary MWFs were being utilized in the facility at the time of the site visit: ELF Atochem Atoguard RS (a semi-synthetic), United Lubricants UL-SS-643 (a semi-synthetic), Castrol Cooledge 6631 (a soluble oil), and Texaco Transultex CF F (a straight oil). Transultex CF F is used only in the gear cutting operation in department 38. Castrol Cooledge 6631 is used primarily in grinding operations in departments 35, 37, and 39. UL-SS-643 is used in the Department 31 Bendix line. The remaining areas utilize Atoguard RS, which is the highest volume MWF used in the facility.

The central systems are monitored twice a week for tramp oil (by centrifuge), concentration (refractometer), pH (pH meter), and bacteria/fungal growth (MCE® Combi Dipslide). The results are recorded and transmitted to appropriate management personnel for follow-up, if needed. For bacterial growth, results $<10^4$ colonies/milliliter (ml) are considered by the MWF contractor to be "in control," and $\geq 10^5$ colonies/ml indicate the need for maintenance. Systematic maintenance of MWFs is not conducted on individual machine sumps. Operators of machines with individual sumps add water to the MWF depending on the appearance of the fluid. Biocides are not typically added to the Atoguard RS (it is formulated with a triazine bactericide). Kathon® or a triazine biocide are used in the United Lubricants product and are added based on microbiological results.

Personal protective equipment (PPE) available consists of cotton gloves and, in some cases, cloth aprons. With the exception of Department 38, where straight oil MWF is used, none of the machines are equipped with local exhaust ventilation. Employees frequently use compressed air to dry parts and to clean off the machines at the end of the shift. A joint management-employee MWF committee addresses health and safety issues related to MWF.

METHODS

Industrial Hygiene

Nine full-shift personal breathing zone (PBZ) air samples for MWF were collected on pre-weighed 37-millimeter polytetrafluoroethylene (PTFE - Zefluor®) filters at an air flow rate of 2.0 liters per minute (l/min) using battery-powered Gillian air sampling pumps. The filters were analyzed by a provisional ASTM E34.50 Committee method modified by NIOSH to separate MWF from co-sampled material. This method removes interferences from contaminating materials such as environmental dusts and (infrequently) metal particles. Following sampling, the filters were weighed on a microbalance and extracted using a ternary solvent blend (the solvent blend was selected from solubility tests on the respective metalworking fluid). The difference in the weight of the filter before and after sample collection yielded the total particulate mass sampled. The difference in the weight of the filter before and after extraction was the weight of the MWF. The departments sampled are listed in Table 1.

Seventeen bulk samples of MWFs (the machines sampled are listed in Table 2) were collected in sterile 150-milliliter specimen cups from the machining tool zone (except where indicated otherwise on Table 2). The MWF from this zone comprises fluid most likely associated with airborne and dermal exposure. After collection, the samples were packaged and shipped on ice by overnight delivery to a NIOSH contract laboratory (Microbiology Specialists Incorporated, Houston, Texas). Sequential dilutions from each bulk sample were made and then plated on agar for analysis for fungi, aerobic bacteria, and mycobacteria. The plates were incubated at room temperature, then the colony forming units (CFUs) were counted and the genus and species identified.

The pH of each bulk MWF sample was recorded at the time of collection. The pH was measured with Phydrion Insta-Check paper (Micro Essential Laboratory, Brooklyn, New York). The wet pH paper was compared to a color chart to determine the pH of the fluid.

Medical

Informal interviews with employees working in machining areas revealed that a number of employees had experienced respiratory symptoms in the recent past. To further evaluate reported symptoms among Meritor employees exposed to MWF, a questionnaire was distributed in November 1998 to all plant employees. The questionnaire was distributed by mail to the home address of each employee; the mailing addresses were provided by Meritor. The purpose of the questionnaire was to determine the prevalence of symptoms, to address the question of whether reported symptoms may be related to working with MWF, and to potentially identify employees who might have a respiratory disorder related to workplace exposure to MWF (such as HP or occupational asthma). The questionnaire included a cover letter and questions about demographic factors (age, gender, etc.), symptoms potentially related to MWF exposure, and medical and work history.

Survey participants identified by the questionnaires as potentially having a MWF-related respiratory illness were offered a standard clinical pulmonary (lung) evaluation. A contract with the University of Cincinnati Center for Occupational Health (UC COH) was arranged so that the medical evaluations could be done without charge to the participants. It was explained to the participants selected for the medical evaluations that travel, room, and board expenses for the evaluations, to be performed in Cincinnati, were the responsibility of the participant.

The following criteria were used in selecting those participants in the questionnaire survey who appeared to have MWF-related respiratory illness: (1) self-reported work involving exposure to MWF at Meritor; (2) one or more respiratory symptoms (cough, wheezing, chest tightness, or shortness of breath within the past 12 months) **and** two (of four) responses indicating work-relatedness of the respiratory symptoms; and (3) two or more systemic

symptoms (fever, night sweats, chills, flu-like aches, and unusual fatigue) occurring daily or weekly within the past 12 months. These three criteria were used initially to identify employees with possible MWF-related respiratory illness. Other criteria used in selecting employees for clinical evaluation included: (4) a change in job duties due to symptoms; (5) current symptoms; and (6) two or more of the respiratory symptoms listed in #2.

Due to resource limitations, medical evaluations could be offered to a maximum of 10 participants. The 10 participants who were selected (see Results section) were sent a letter in February 1999 explaining the HHE, the questionnaire survey, and the purpose of the follow-up medical evaluations. A follow-up phone call was made by the NIOSH medical officer. After the initial contact, the NIOSH medical officer was not to be directly involved with the medical evaluations performed at the UC COH; the evaluations were to be performed as standard medical evaluations per usual UC COH protocol.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[3] NIOSH encourages employers to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10- hour workday. Some substances have recommended short-term exposure limits (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Metalworking Fluids

MWF are used for lubrication, cooling, and removal of metal chips during machining operations. Substantial evidence indicates that workers exposed to MWF aerosols have an increased risk of nonmalignant (non-cancerous) respiratory disease (including irritant bronchitis, occupational asthma, and HP) and skin diseases.[5] To prevent or greatly reduce the risk of adverse health effects, NIOSH recommends that exposures to MWF aerosols be limited to 0.5 milligrams per cubic meter (mg/m^3) for total particulate mass (or 0.4 mg/m^3 for thoracic

particulate mass) as a TWA for up to 10 hours per day during a 40-hour week.[4] This REL is based on evaluation of the health effects data, sampling and analytical feasibility, and technological feasibility. However, concentrations of MWFs should be kept below the REL where possible because some workers have developed work-related asthma, HP, or other adverse respiratory health effects to MWFs when exposed at lower concentrations. Specifically, cases of HP have been associated with MWF concentrations both above and below the REL; it is not clear whether reducing MWF exposure concentrations alone will effectively reduce the risk of HP.[5]

In the sampling for MWF done in this HHE, the extracted MWF concentration was determined, as well as the total particulate mass concentration. NIOSH is evaluating this extracted MWF method, but has decided at this time not to propose an REL based on this method because it has not been fully evaluated. Currently, little or no evidence suggests that "extractable" MWF is superior to total particulate mass measurement as a predictor of adverse health effects from MWF aerosols. However, extractable MWF aerosol measurement may be helpful in environments where there are simultaneous exposures to other particulates.[5]

Microbial Growth and Endotoxins in MWF

Water-based MWFs are excellent nutritional sources for many kinds of bacteria and fungi. Historically, microbial contamination of MWF has been a problem primarily because it can affect fluid quality and performance. Fluid degradation from microorganisms can cause changes in fluid viscosity, and the acid products of fermentation may lower the pH of MWF, causing corrosion and leaks in the MWF system.[5] The predominant microbial species routinely recovered from MWFs are frequently the same as those routinely recovered from natural water systems.[5] Although most bacterial species found in MWFs are Gram-negative (bacteria that do not retain Gram stain), the microbial populations within such MWF samples are continually changing.[5,5] Microorganisms can potentially act as antigens that can stimulate the immune system and result in sensitization. If the sensitized person is repeatedly exposed to the sensitizing antigen, an allergic response may occur (while a non-sensitized person would have little or no reaction). Interest has focused on the possible involvement of microbial antigens in recent clusters of HP among workers exposed to MWF aerosols.[6,7] Although the acid-fast organism *Mycobacterium chelonae* has been found to be present in some MWF associated with outbreaks of HP, the significance of finding any particular fungal or bacterial species in MWF is not clear at this time.[5,8] In addition, potential etiologic agents of HP in the machining environment may not be limited to bacterial antigens.[5]

Generally, the fungi isolated from MWFs are common species that live on decaying organic matter in the environment and are not usually the major microbial contaminant in MWFs. Most water-based fluids have low concentrations of fungi, except when a bloom (which is often caused by a dramatic decrease in bacterial contamination) occurs.[9,10] Although no reports have been published about fungal diseases from contaminated MWF exposures, some known health hazards are associated with fungi exposure. For example, exposure to fungi may cause allergic disease in some persons. *Cephalosporium*, *Penicillium*, and *Aspergillus* species are common MWF contaminants and have been implicated with HP (although not in a MWF environment). Fungi also produce toxic metabolites; *Fusarium* has been reported to produce toxins that cause dermal toxicity.

Endotoxins, the principle surface antigens in Gram-negative bacteria, are contained in the cell wall of all Gram-negative bacteria. Endotoxins are generally released from these bacteria when they die. MWFs that have high concentrations of Gram-negative bacteria frequently have high levels of endotoxin. Aerosolized endotoxins are suspect causative agents of occupationally related respiratory effects (e.g., chronic bronchitis, abnormal cross-shift declines in pulmonary function, asthma) among workers exposed to MWF aerosol.[5]

At the present time, there are neither specific microorganisms in MWFs linked to specific, exposure-related health effects nor specific criteria concerning the level of total microbial contamination that may be related to potential health effects. Most MWF suppliers set limits of 10^5 bacteria per milliliter as the maximum bacterial level and zero as the maximum fungi level. If the count exceeds these levels, some form of treatment is likely necessary.[6] These supplier limits are not health based, but are based on maintaining a high quality MWF for optimal parts production.

RESULTS

Industrial Hygiene

The results of the personal air monitoring can be found in Table 1. The total particulate mass concentrations ranged from 0.33 to 1.29 mg/m^3. Five sample concentrations were over the 0.5 mg/m^3 NIOSH REL: a Department 31 Bendix operator (0.90 mg/m^3), a Department 33 Bendix operator (1.29 mg/m^3), a Department 33 Bullard operator (1.17 mg/m^3), a gear cutter in Department 38 (0.83 mg/m^3), and a grinder in Department 39 (0.59 mg/m^3).

The difference between the total particulate mass concentration and the MWF concentration represents non-soluble particulate in the environment and particulate contamination in the MWF. Even when the MWF component was isolated with the extraction procedure, the aerosol concentrations in four of the five samples discussed above remained in excess of the REL. In several samples (as indicated in Table 1), machines were down part of the day or the worker was at a meeting for a substantial time. These exposures would likely have been higher if the workers operated their machines for the entire day.

The results of the bulk MWF microbial analysis can be found in Table 2. *M. chelonae* was the most frequently isolated organism from machines using Atoguard RS. A variety of other bacteria, all Gram-negative, were isolated from various MWFs. Some MWFs had bacteria concentrations ranging from 10^5 - 10^7 colony forming units per milliliter (CFU/ml). The pH of MWFs from the Landis grinder #9-3813, K-Line 9-5733, and Cinc. grinder #9-5326 were lower (pH of 7) than the other MWFs; depressed pH is sometimes due to current or previous excessive bacteria growth. Four MWFs samples had fungal growth (*Aspergillus spp*. and *Fusarium spp*.). It should be noted that triazine biocides (the type in Atoguard RS) are generally considered less effective than non-formaldehyde releaser biocides in inhibiting fungal growth;[5] in some circumstances, low concentrations of triazine biocides can actually stimulate fungal growth.[6]

Medical

One hundred thirty-one (15%) of the 852 questionnaires sent out for the medical survey were returned. Of the 131 respondents, 115 (88%) were male, and the mean age was 45 years (ages ranged from 21 to 63 years). Ninety-seven (75% of the 131) reported having ever worked with MWF at Meritor; those employees reported an average of nine years of work with MWF. Eighty-three (63%) respondents reported currently working in one of the machining departments.

Ninety-seven (74 % of 131) respondents reported work at Meritor involving MWF, 39 (30% of 131) reported work-related respiratory symptoms, and 11(8% of 131) had systemic symptoms; eight employees met all three criteria and thus met the initial criteria of having MWF-related respiratory illness. However, in two of these eight employees, respiratory symptoms began while the person was working in a non-machining department. Furthermore, both of those employees reported a relatively short history of MWF exposure and a long history of smoking cigarettes. Therefore, both were excluded from further consideration for clinical evaluation at the UC COH since their respiratory illness seemed not primarily attributable to MWF. The other six employees were offered medical evaluations at the UC COH.

Among the 39 employees who had work-related respiratory symptoms, 35 (90%) reported a history of working with MWF at Meritor, 11 (28%) reported a change in job duties due to their symptoms; and 26 (67%) reported two or more of the four primary respiratory symptoms (cough, shortness of breath, chest tightness, or wheezing) and a current problem with one or more of those symptoms. There were four employees who reported work-related respiratory symptoms and who also reported: (1) having two or more of the respiratory symptoms in the past year, with at least one being current; **and** (2) changing their job duties due to their symptoms. These four employees also were offered medical evaluations at the UC COH.

In early February 1999 letters were mailed to the 10 employees who were offered medical evaluations. The letters explained the HHE and the purpose of the medical evaluations. None of the 10 employees reported in the follow-up telephone calls that they were planning to schedule an evaluation at the University of Cincinnati. Reasons given by the employees for not pursuing the medical evaluations included improved symptoms and financial considerations (time away from work; travel to and from Cincinnati). As of mid-March 1999, none of the 10 employees had called the UC COH office to schedule appointments, and the plans for medical evaluations were discontinued at that point. The 10 potential participants were informed of this by letter, with the recommendation that future medical concerns be evaluated by their personal physicians.

DISCUSSION AND CONCLUSIONS

In this HHE, we found that exposures to MWF at concentrations above the NIOSH REL are occurring among employees in several of the machining departments (Departments 31, 33, 38, and 39) at Meritor. MWF exposure has been associated with increased prevalence of respiratory symptoms, decreases in pulmonary function over a work shift, and the occurrence of occupational asthma.[5] Due to a low participation rate in the questionnaire survey, no conclusions can be drawn regarding the prevalence of respiratory symptoms among Meritor employees; however, a number of Meritor employees did report work-related respiratory symptoms.

The concentrations of bacteria and fungi found in the bulk samples of MWF at this plant are similar to those seen in other evaluations of water-based MWF.[10,11,11] The acid-fast bacillus *M. chelonae* was found to be a primary contaminant of the MWF at Meritor. A recent workshop summarizing information available concerning outbreaks of HP among workers exposed to MWF reported that *M. chelonae* was isolated from the MWF in four of the eight industrial sites which had reported HP cases,[9] although no conclusions regarding etiology of the HP could be made for those outbreaks.

We have no information concerning the MWF exposures of the one Meritor employee diagnosed with MWF-associated HP in 1997. We cannot determine the relationship between MWF-related HP and various parameters of exposure to MWF, such as: (1) the level of aerosol exposures (above or below the NIOSH REL), or (2) the content of the aerosol (type of microbial contamination, particle size distribution, etc.). Reducing MWF exposures, improving the management of MWF systems, and reducing microbial contamination of water-containing MWF are all likely to be important factors in the control of MWF-associated HP and other respiratory health effects.

RECOMMENDATIONS

1. To help prevent respiratory disorders associated with MWF exposure, NIOSH recommends that MWF aerosol levels be reduced to levels below the NIOSH REL. MWF aerosol levels should be decreased for workers in Departments 31, 33, 38, and 39, specifically including the Bendix machines in Departments 31 and 33 and the Bullard machines in Department 33. Meritor should perform an engineering assessment for installation of enclosures or local exhaust ventilation for all or some of the

machines in these areas; the machine manufacturer may be able to provide some assistance in this type of assessment. Increased dilution ventilation in the areas of the machines may also reduce exposures, but this control strategy historically has been less effective than local exhaust ventilation.

Other viable options for reducing MWF aerosols include: minimizing fluid delivery pressure, matching the fluid to the operation, avoiding contamination with tramp oils, minimizing MWF flow rates (especially during non-active times in the cycle), and maintaining accurate control of the MWF chemistry.

2. Meritor should institute a complete health and safety program for MWF, the major elements of which should include: (1) safety and health training, (2) worksite analysis, (3) hazard prevention and control, and (4) medical monitoring of exposed workers.[5] Some of these elements are already in place at Meritor. The objectives of an environmental monitoring as part of this program are to evaluate the effectiveness of work practices and engineering controls, ensure that exposures are below the REL, and identify areas where further reduction in exposures is possible. Industrial hygiene sampling should focus initially on workers that are expected to have the highest exposures (high production areas, etc.); however, all workers or worker groups should be periodically sampled. Industrial hygiene sampling should be conducted at least annually and whenever major process changes take place. In areas where MWF aerosol levels exceed one-half of the NIOSH REL, additional sampling should be conducted every 6 months.[5]

3. The use of compressed air to blow MWF off parts should be minimized or eliminated wherever possible. Compressed air can aerosolize large amounts of MWF, increasing exposures.

4. Some of the local exhaust ductwork on the machines in Department 38 appeared disconnected and/or not functioning effectively. An evaluation of air velocity rates in the ductwork for all machines in that department should be conducted. Maintenance of the mist eliminators should be reviewed to ensure that it is consistent with the manufacturer's recommendations.

5. Machines, machine sumps, or central systems found to be contaminated with microbes should be appropriately treated and/or cleaned following MWF manufacturer's recommendations. Appropriate precautions should be taken to protect the health of workers performing the cleaning. This should include personal protective equipment to minimize skin contact with MWF and contaminants. If there is the potential to generate aerosols during the cleaning process, respirators (following the guidelines discussed in Recommendation #4) should be worn to minimize inhalation of those aerosols.

6. Until exposures can be reduced below the REL through engineering or administrative measures, respiratory protection for workers assigned to tasks where exposures could exceed the NIOSH REL for MWF should be utilized. An air-purifying respirator equipped with an R- or P-series filter would be appropriate. Respirators should only be used within the constraints of a comprehensive respiratory protection program (29 CFR Part 1910.134). Users must be medically cleared, trained, and fit-tested for their assigned respirator. Because respiratory protection is usually the least desirable method of reducing exposures, the use of respiratory protection should not be considered a permanent solution.

7. Dermal contact with MWFs should be reduced as much as possible by modification of work practices and the use of appropriate personal protective equipment. Employees should use techniques to minimize the amount of MWF that drips, spills, or sprays onto them. Employees should be provided with rubber gloves that cover the forearm and a rubber-front apron to prevent MWF from saturating their clothing.

8. In some areas, cigarette butts were noted around the machines. Eating, drinking, and smoking should not be allowed along the production lines. Workers should be encouraged to wash hands before engaging in these activities. Workers should be educated

about the importance of not contaminating MWF with cigarettes, saliva, or other inappropriate materials. When cleaning the floor and machines at the end of the shift, workers should ensure that floor debris, floor cleaners, etc. are not washed into the MWF.

9. Employees should be encouraged to report all potential work-related health symptoms to appropriate health care personnel. As part of the safety and health program mentioned in recommendation #2, Meritor should monitor reported health problems in a systematic manner designed to identify particular job duties, work materials (such as particular MWFs), machines, or areas of the plant which may be associated with particular health effects. Individuals with definite or possible occupational illnesses should be protected from exposures to presumed causes or exacerbators of the disease, using engineering (e.g., isolation, and ventilation) and/or administrative (e.g., work and hygiene practices, and housekeeping) controls if possible, or with PPE. In some cases, workers may have to be reassigned (also considered an administrative control measure) to areas where exposure is minimized or nonexistent. In such cases, the reassigned worker should retain wages, seniority, and other benefits that might otherwise be lost by such a job transfer. A complete discussion of an occupational safety and health program pertaining to MWF, including medical monitoring, fluid maintenance, engineering controls, and environmental surveillance, is contained in the NIOSH Criteria Document.[5]

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TABLE 1
Meritor Automotive, HETA 98-0050
Personal Air Samples for Metalworking Fluids
February 11, 1998

Job	Department/ Machine #	Fluid Type	Sample Time (minutes)	Total Particulate (mg/m^3)[a]	MWF Concentration (mg/m^3)
Bendix Operator	31 9-5735	United Lubricants UL-SS-643	237	0.90	0.72[b]
Lathe Operator	39 9-5885	ELF Atochem Atoguard RS	463	0.33	0.19
Grinder	39 9-3813	Castrol Cooledge 6631	457	0.59	0.45[c]
Gear Cutter	38 9-2742/3133	Texaco Transultex CF F	456	0.83	0.52
Lathe Operator	36 9-3711/3712	ELF Atochem Atoguard RS	453	0.42	0.23
Orion Operator	32 9-5508, 5509	ELF Atochem Atoguard RS	381	0.44	0.27[d]
Bullard Operator	33 9-3948, 3949	ELF Atochem Atoguard RS	364	1.17	0.81
Bendix Operator	33 9-3962	ELF Atochem Atoguard RS	365	1.29	1.00
OD Grinder	37 9-1721/1722	Castrol Cooledge 6631	426	0.46	0.36
Limit of Detection (based on sample volume of 800L)				0.001	0.001
NIOSH Recommended Exposure Limit				0.50	

[a]Milligrams per cubic meter air sampled
[b]machine down about half of the day
[c]worker at meeting, away from machine about 1.5 hours
[d]machine down part of day
Atoguard RS is a semisynthetic coolant
UL-SS-643 is a semisynthetic coolant
Cooledge 6631 is a soluble oil
Transultex CF F is a straight oil

TABLE 2
Meritor Automotive, HETA 98-0050
Metalworking Fluid Bulk Samples,
February 11, 1998

Department/ Machine #	**Machine Model**	**Fluid Type**	**pH**	**Bacteria (colony forming units/milliliter)**	**Fungi (colony forming units/mL)**
32 9-5509	Orion 2300	ELF Atochem Atoguard RS	9-10	>6.0 x 10^3 *Mycobacterium chelonae*	no growth
33 9-3962	Bendix	Elf Atochem Atoguard RS	9	>6.0 x 10^3 *M. chelonae*	1.5 x 102 *Aspergillus niger* group
33 9-3948	Bullard	Elf Atochem Atoguard RS	9	>6.0 x 10^3 *M. chelonae*	no growth
32-33 9-5611 Henry	Mori	Elf Atochem Atoguard RS	9-10	>6.0 x 10^3 *M. chelonae*	no growth
36 9-3711	Motch (collected from hose) lathe	Elf Atochem Atoguard RS	9-10	2.8 x 10^2 *M. Chelonae* 4.7 x 10^2 *Comamonas testosteroni* 6.0 x 10^1 *Pseudomonas alcaligenes* gp. 8.1 x 10^2 total CFU	1.0 x 101 *Fusarium* spp.
36 9-3711	Motch (collected from pit) lathe	Elf Atochem Atoguard RS	9-10	9.1 x 10^4 *C. testosteroni* 2.7 x 10^4 *Citrobacter freundii* 6.0 x 10^3 *Proteus vulgaris* 1.2 x 10^5 total CFU	no growth
39 9-3813	Landis grinder	Castrol Cooledge 6631	7	3.4 x 10^6 *Alcaligenes piechaudii* 6.0 x 10^5 resembles *Sphingomonas* spp. 1.3 x 10^4 *P. alcaligenes* gp. 5.0 x 10^3 *Citrobacter freundii* 4.0 x 10^6 total CFU	no growth

TABLE 2 Continued
Meritor Automotive, HETA 98-0050-2733
Metalworking Fluid Bulk Samples,
February 11, 1998

TABLE 2 Continued
Meritor Automotive, HETA 98-0050-2733
Metalworking Fluid Bulk Samples,
February 11, 1998

39 9-5885	Monarch lathe	Elf Atochem Atoguard RS (not central)	9	>6.0 x 10^3 *M. chelonae*	No growth
39 9-4961	LeBlond Makino lathe	Elf Atochem Atoguard RS	9-10	>6.0 x 10^3 *M. chelonae*	3.5 x 102 *Aspergillus niger* gp.
35 9-3911	Cincinnati Milicron, hydromation grinding	Castrol Cooledge 6631	9	3.9 x 10^6 *Acinetobacter* spp. 1.2 x 10^6 *Comamonas acidovorans* 4.0 x 10^3 *Citrobacter freundii* 5.1 x 10^6 total CFU	No growth
31 K-Line 9-5733	Motch 7-stage drill	United Lub. UL-SS-643	7	No growth	No growth
37 9-5326	Cincinnati grinder	Castrol Cooledge 6631	7	8.5 x 10^6 *Ochrobactrum anthropi* 2.7 x 10^6 *Acinetobacter* spp. 5.0 x 10^5 *Shewanella putrefaciens* 5.0 x 10^3 *Bacillus cereus* 1.2 x 10^7 total CFU	No growth
37	Heald grinder	Castrol Cooledge 6631	9	2.7 x 10^6 *Pseudomonas alcaligenes* 3.0 x 10^5 *Serratia liquefaciens* 2.0 x 10^5 *Shewanella putrefaciens* 2.0 x 10^3 *Bacillus cereus* 3.0 x 10^1 *Serratia marcescens* 3.2 x 10^6 total CFU	8.0 x 101 *Aspergillus niger* gp.

TABLE 2 Continued
Meritor Automotive, HETA 98-0050-2733
Metalworking Fluid Bulk Samples,
February 11, 1998

33 (oil station)	(clean fluid)	Elf Atochem Atoguard RS	8	no growth	no growth
35, 39	(pre-mix)	Elf Atochem Atoguard RS	10	2.8×10^2 *M. Chelonae*	No growth
37, 39	(clean fluid)	Castrol Cooledge 6631	9	No growth	No growth
35, 39	(clean fluid)	United Lub. UL-SS-643	10	No growth	No growth

Atoguard RS is a semisynthetic coolant
UL-SS-643 is a semisynthetic coolant
Cooledge 6631 is a soluble oil
Transultex CF F is a straight oil

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html

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